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Strategy of Marine Environmental Management at Bintan Waters

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Abstract

Sustainable management has been becoming a global development mainstream. The concept of sustainable development has become a middle way towards development and environment, as well as coastal and marine resources management. Various development activities at marine sectors such as : captured fisheries, marine tourism, sea transportation etc, shall always cause influence and stress towards resources and environment. Management is defined as systematic and planned effort which is conducted to ensure the sustainability of a program or activity. The approach of AHP (Analytic Hierarchy Process) analysis is aimed to obtain a strategic marine environmental management priority. From the result of analysis, priorities for actors/stakeholders were obtained in managing marine environmental of Bintan Waters in order to prevent the marine pollution caused by oil spill sequentially as follows : Regional Government (0.497), NGO (0.246), Universities (0.121), Local Community (0.076) and Tour Management (0.060).

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First priority related to Marine Environmental Resources Utilization Criteria at Bintan Waters is captured fisheries (0.540), second priority is tourism (0.297) and third priority is sea transportation (0.163). First priority on marine environmental resources utilization criteria at Bintan Waters is Coordination Improvement among Related Institutions with score of 0.630, second priority is Monitoring Improvement of Pollution Control with score of 0.218 and third priority is Technology Improvement of Pollution Control with score of 0.151.

Keywords: Analytic Hierarchy Process; pollution; sustainable management.

1. Introduction

Sustainable management approach becomes the most main alternative. Sustainable management is one of sustainable development technical definitions. The term sustainable development was introduced for the first time in 1987 by *World Commission on Environment and Development* (Brundtland Commission) through the book *Our Common Future*. According to [1] that *sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs*. Literally-wise, it was defined as an effort to meet current generation needs without decreasing future generation ability to meet its needs. In terms of its implementation in Indonesia, sustainable development is defined as conscious and planned effort that combines aspects of environmental, social and economical, into development strategies to ensure the environment completeness as well as safety, ability, welfare and living quality of both current and future generations (the Consitution of Republic of Indonesia No.32/2009). Further [2] stated that sustainable development basically covers three important dimensions, namely; economy, social and ecology. Thus, the aim of sustainable development focuses on the sustainability of high economic growth, welfare of social equity and ecological at the level of harmonious and balanced living system (ecological sustain). According to [3], an activity of development (including natural resources management with its various dimensions) would be defined as sustain when it is economically, ecologically and socially sustainable.

Pollution at coastal environment may occur at any waters in the world especially when oil spills occurs and may cause pollution which is an intrusion of undefined substances into environment that change physical, chemical and biological characteristics of the environment. Specific impact of oil spill towards marine and coastal waters environment depends on the amount of oil spill, location of incident and time of incident [4]. In line with this, [5] stated that level of damage caused by oil spill depends on the amount of oil spill, its type and chemical compound characteristics contained in the spilled oil, as well as the ecosystem sensitivity and so the oil spill may cause more widespread marine pollution due to sea current and sea wave.

Thus, in managing marine environment at Bintan Waters, an approach of sustainable development is needed together with the formula of various marine environment management strategy alternatives at Bintan Waters. Therefore, AHP approach becomes analytic tools to answer the goal mentioned above. This model shall outline multifactors issue as well as complex multi criteria into something hierarchical [6].

2. Materials and Methods

2.1. Study Area

The study was conducted in January – June 2015, situated at the eastern side of Bintan Regency Waters precisely at Nikoi Island Waters, Beralas Pasir Island, Penyusuk Island, Karangge Island and Payung Island. These islands area belongs to Gunung Kijang District of Bintan Regency. Detail is as follows :



Figure 1: The research area show is shown by a red square

(Source.: Google Map)

2.2. Types and Source of Data

Types of data used in alternative assessment of marine environmental management strategy at Bintan Waters were primary data. It were collected *in situ* from assessment objects, as in measurement, observation as well as interview [7]. Data source was collected from experts/respondents opinions as the representatives of actors, consisting of; Regional Work Unit, Entrepreneur Association, Universities, NGO and community.

2.3. Data Collecting

Methodology of data collecting in alternative assessment of marine environmental management strategy at Bintan waters was survey approach as an interview method. The number of respondents as experts were five persons, each was the representative of Regional Work Unit, Entrepreneur Association, Universities, NGO and community. Questionnaire developed was a closed questionnaire, with ordinal data by using [8] . Detail is as follows :

Table 1: Scoring Scale of AHP

| Intensity of Interest | Description |
|-----------------------|---|
| 1 | Both elements are important |
| 3 | One element is a bit more important than the other element |
| 5 | One element is more important than the other element |
| 7 | One element is clearly more important than the other element |
| 9 | One element is absolutely more important than the other element |
| 2,4,6,8 | Scores in between both nearby considered scores |

Source: [8]

The usage [8] was conducted by pairwise comparison technique, where all at each level are pairwise compared using score scale 1 to 9. As a base of this pairwise comparison questionnaire arrangement, a structure/hierarchy/level of the assessment was arranged. Detail is as Figure 2 :

2.4. *Data Analysis*

Methodology of data analysis on Alternative Assessment of Marine Environmental Management Strategy at Bintan Waters was conducted using AHP approach (*Analytic Hierarchy Process*). AHP is a support model developed by Thomas L. Saaty in 1994. This decision support model will outline multifactors issues as well as complex multi criterias into something hierarchical. According to [9], hierarchy was defined as a representation of a complex issue in a multi level structure, where the first level is the objective/focus, followed by next level, which is criteria, sub criteria, etc. up to the last level as alternatives. Further, AHP is a decision making method that involves numbers of criterias and alternatives chosen based on decision of all related hierarchical criterias. By using hierarchy, a complex issue can be outlined into groups which is later hierarchically arranged so that an issue will be more structured and systematic. According to [10], AHP has several advantages in explaining decision making process because it can be described graphically in order to make it easy to understand by all stakeholders involved in making the decision.

AHP operational steps in analysing alternative of marine environmental management strategy at Bintan Waters are as follows :

- To create and arrange hierarchy structure, covering actors, aspects and strategy alternatives.
- To define the focus/objective/goal, namely : alternative of marine environmental management strategy at Bintan Waters due to oil spill.
- To define the actors : Regional Government, NGOs, Universities, Tour Management and community.
- To define utilization aspects : captured fisheries, tourism and sea transportation.
- To determine strategy alternatives/recommendations, namely : Coordination Improvement among

Related Institutions, Monitoring Improvement of Pollution Control and Technology Improvement of Pollution Control.

- To create pairwise comparison matrix that describes relative contribution or influence of each element to the above goal or criteria.
- To define pairwise comparisons to obtain an overall assessment amount of $n \times [(n-1)/2]$, where n is the number of compared elements.
- To run Expert Choice Software.

Expert Choice is the software used to solve problems based on *Analytic Hierarchy Process* (AHP) method, by comparing several alternatives with certain criterias. *Expert Choice* provides tools to analyse the decision making, giving quicker decision, also better justifiable final decision.

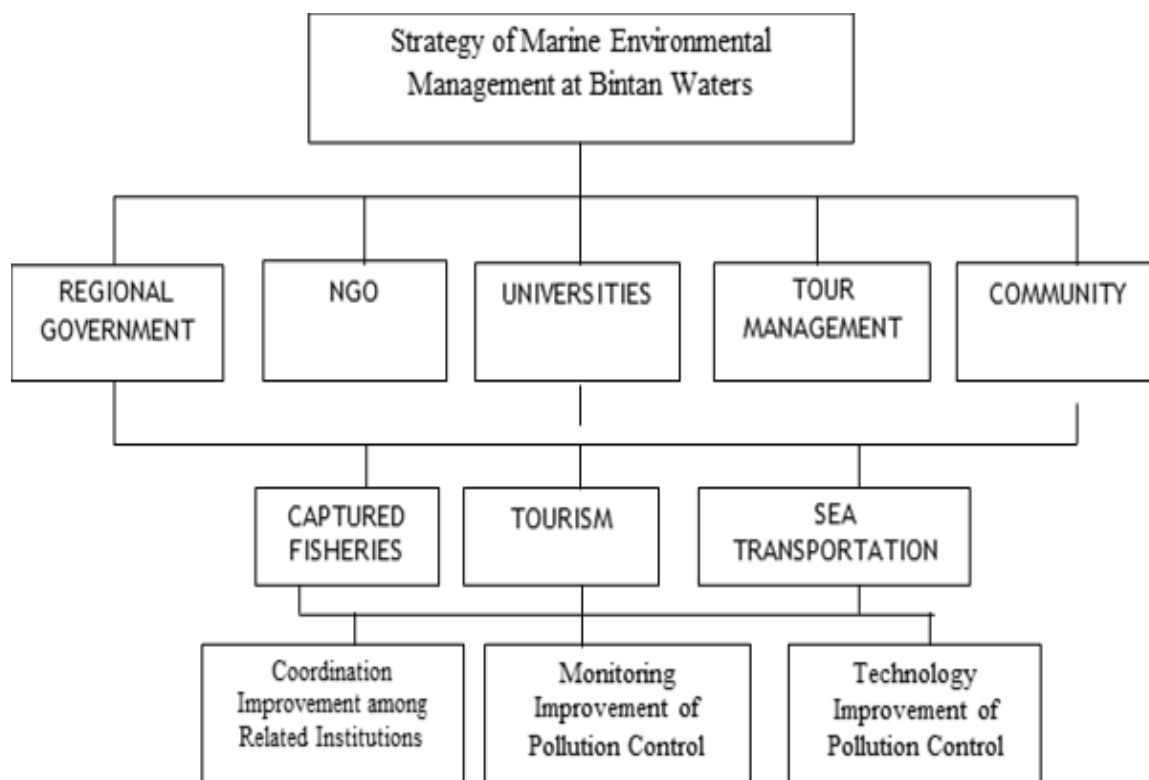


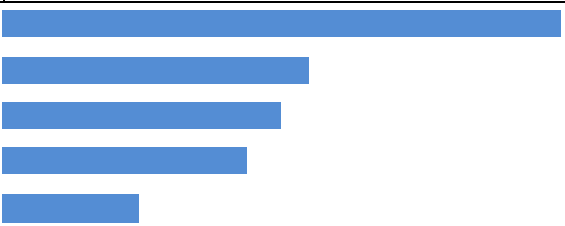
Figure 2: Hierarchy/Structure on Alternative Assessment of Marine Environmental Management Strategy at Bintan Waters

3. Results

3.1. Priority of Actors (Stakeholders)

Actors take role as stakeholders in marine environmental management at Bintan Waters, which cover; related Regional Government, NGO, Universities, Tour Management and Community. These five main actors are expected to synergize in every action plan of marine environmental management at Bintan Waters, especially in preventing marine pollution due to oil spill. Below is the output of AHP analysis towards actors/stakeholders in marine environmental management of Bintan Waters.

Table 2: Actors/Stakeholders Priority

| Decision of Marine Environmental Management of Bintan Waters | | |
|--|-------|--|
| Actors/Stakeholders | Value | Decision Scores |
| Regional Government | .497 |  |
| NGO | .246 | |
| Universities | .121 | |
| Community | .076 | |
| Tour Management | .060 | |
| | 0.00 | 0.500 |

Analysis result showed that Regional Government was the main priority stakeholder/actor in marine environmental management at Bintan Waters with score of 0.497 or 49.70% from total score. Further the second priority up to the fifth priority actor in score order were as follows : NGO with score of 0.246 or 24.60%, Universities with score of 0.121 or 12.10%, Community with score of 0.076 or 7.60% and Tour Management with score of 0.060 or 6.0%. This showed that main actor in managing the marine environmental especially in preventing marine pollution due to oils spill is Regional Government. This was so that marine environmental management is a complex management process with many actors playing roles in it, thus the role of regional Government starting from initiation process until the implementation has become very crucial.

3.2. Priority of Utilization Aspect

Resource utilization became one of scoring criterias in determining the strategy of marine environmental management at Bintan Waters in order to prevent marine pollution due to oil spill. In general, there were three main utilization categories at Bintan Waters, namely; captured fisheries, tourism and sea transportation. All three activities were potential to cause marine pollution impact as oil spill etc. Below is the AHP analysis output for the criteria of marine environmental utilization aspect at Bintan Waters.

Table 3: Priority of Utilization Aspect

| Decision of Marine Environmental Management of Bintan Waters | | |
|--|-------|-----------------|
| Dimension | Value | Decision Scores |
| Captured Fisheries | .540 | |
| Tourism | .297 | |
| Sea Transportation | .163 | |
| | 0.00 | 0.550 |

Analysis result showed that utilization of captured fisheries criteria was the first priority with score of 0.540 or

54.00%. Second priority was tourism with score of 0.297 or 29.70% and third priority was sea transportation with score of 0.163 or 16.30%. High score of captured fisheries utilization was caused by resources sensitivity level towards the incident of oil spill. Oil spill can cause mass fish death and further can cause the cessation of captured fisheries activities. Similar case also happened for tourism activities which is also the utilization of marine resources with high sensitivity level. Bintan waters has a very potential captured fisheries chance that bordered by Natuna Sea which is one of the world center on fish production. As well as the tourism potential, where marine tourism is a tourism potential to be developed in the region.

3.3. Priority of Management Strategy

Strategy alternative of marine environmental management at Bintan Waters is an implementative strategy in order to prevent marine pollution caused by oil spill. Below is the AHP analysis output for alternative strategy priority of marine environmental utilization aspect at Bintan waters.

Table 4: Priority of Alternative Strategy

| Decision of Marine Environmental Management of Bintan Waters | | |
|---|--------------|------------------------|
| Alternative Strategy | Value | Decision Scores |
| Coordination Improvement among Related Institutions | .630 | |
| Monitoring Improvement of Pollution Control | .218 | |
| Technology Improvement of Pollution Control | .151 | |
| | 0.00 | 0.116 |

Analysis result showed that in general from the perspective of the alternative strategy of marine environmental management at Bintan Waters, first priority is Coordination Improvement among Related Institutions with score of 0.630 or 63.00%. Second priority is Monitoring Improvement of Pollution Control with score of 0.218 or 21.80% while third priority is Technology Improvement of Pollution Control with score of 0.151 or 15.10%. In implementing management strategy, a planner must understand ways on how natural environment and human activities relate to each other to form a system (Nandi 2014). Coordination issues in marine environmental management including Bintan Waters, have become classic case that generally happens. Minimum coordination followed by various complex interests, often cause neglected coordination efforts. In implementing ICZM, a planner must understand ways on how natural environment and human activities relate to each other to form a system [11].

4. Conclusion

The first priority of actors/stakeholders in marine environmental management including at Bintan Waters in order to prevent marine pollution due to oil spill sequentially are; Regional Government, NGO, Universities, Community and Tour Management. The first priority related to criteria of marine environmental management

including Bintan Waters are captured fisheries, second priority is tourism, and third priority is sea transportation. The first priority for alternative strategy of marine environmental management at Bintan Waters is Coordination Improvement among Related Institutions, second priority is Monitoring Improvement of Pollution Control, while the third priority is Technology Improvement of Pollution Control.

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